Capturing and Displaying Uncertainty in the Common Tactical/Environmental Picture

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LONG-TERM GOALS

The long-term goal of this project is to develop methods to characterize and display the uncertainty in target state estimates that result from uncertainty in environmental estimates.

OBJECTIVES

The objectives of this project for FY02 were (1) were to work with ARL/UT to develop methods for applying the likelihood functions to the Echo Tracker Classifier (ETC) process and to determine the effect of environmental uncertainty on the likelihood ratio functions so produced, and (2) to develop methods for incorporating and displaying this uncertainty in a Likelihood Ratio Tracker (LRT)

APPROACH

Metron is part of a larger team headed by APL/UW that includes NRL-SSC, NRL-DC, ARL/UT., and Oregon State University, all funded under the ONR Capturing Uncertainty Directed Research Initiative (DRI). Metron's role in the project is to develop methods of reflecting uncertainty in environmental predictions in likelihood functions used by Bayesian trackers and to represent the resulting uncertainty that this produces in the target state estimate generated by a Bayesian tracker. We are working with ARL/UT to develop a statistical description of the data received by a monostatic active sonar and to construct likelihood functions based on this description. These likelihood functions will be used in a Likelihood Ratio Tracker (LRT).

WORK COMPLETED

We have worked with ARL/UT to develop two likelihood descriptions for characterizing uncertainty at both the signal and information processing level of an active monostatic sonar. The first is a cluster-based likelihood function that was developed using as its basic measured input the mean position of threshold crossings in a cluster and the number of such clusters, as determined by the Echo Tracker Classifier (ETC) automated active sonar system. The second is a measurement log-likelihood ratio (LLR) function based on beamformer output and independent model predictions of mean reverberation. Preliminary comparisons (see Figure 1) made by ARL/UT suggest the LLR may provide a higher signal-to-noise ratio compared to the standard normalizer used in ETC.

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14. ABSTRACT
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In addition we have been working with NRL-DC to develop methods of displaying the uncertainty in the target state estimates produced by a Bayesian tracker such as Nodestar or LRT.

RESULTS

We have established an approach for applying Likelihood Ratio Tracking to active monostatic sonar. The next step is to incorporate and represent environmental uncertainty in the likelihood functions and the resulting state estimates.

IMPACT/APPLICATIONS

This work should provide the basis for incorporating and displaying uncertainty in target state estimates produce by Bayesian trackers due to uncertainty in environmental predictions such as propagation loss and sound speed. The specific transition target is the US Navy's Common Undersea Picture (CUP) Program..

TRANSITIONS

None.

RELATED PROJECTS

The Integrated ASW project is developing and testing a version of the Likelihood Ratio Tracker (LRT) for use in combining below threshold detections from multiple platforms such as multistatic active detections from IEER and a DDG to produce improved detection performance. The technology developed in this DRI could be incorporated into this version of LRT.

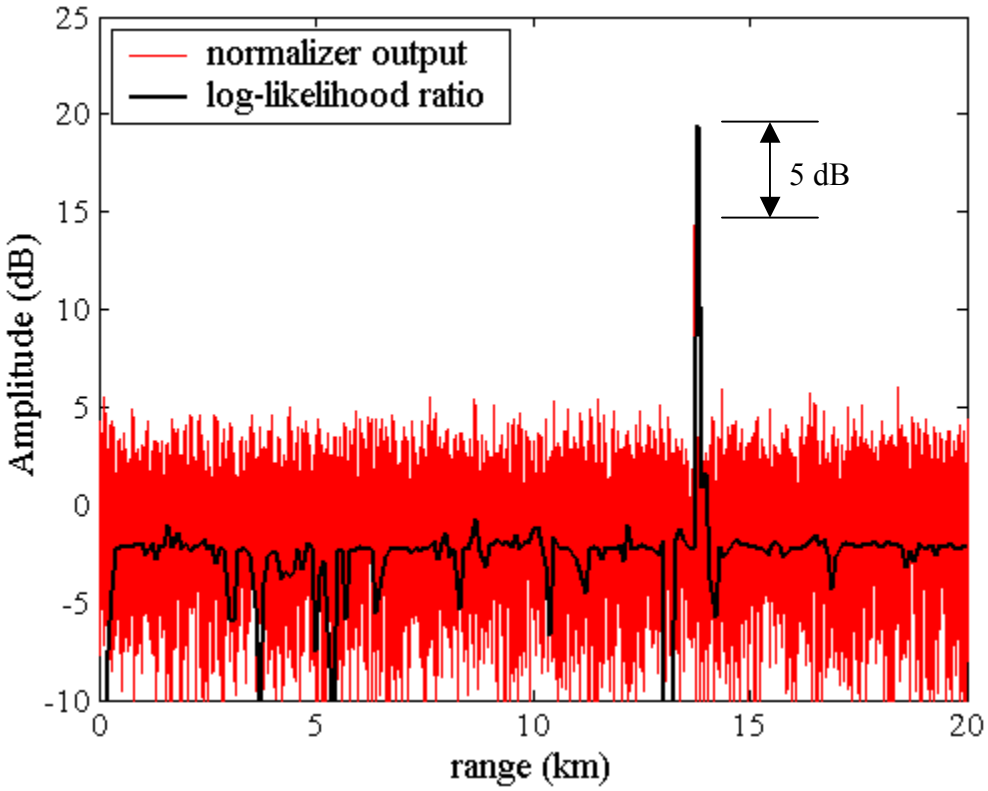

Figure 1: Plot of the time series based log-likelihood ratio versus output from the ETC normalizer. A 5 dB gain is achieved on the target, with significant noise reduction.